*Article*

Understanding Pro-Environmental Behavior of Citizen Science: An Exploratory Study of the Bird Survey in Taoyuan's Farm Ponds Project

Shan-Hui Chao [1], Jin-Zhang Jiang [1,2], Kuan-Chu Wei [3], Eric Ng [4], Chia-Hsuan Hsu [5,*], Yi-Te Chiang [3] and Wei-Ta Fang [3,*]

1   School of Media & Communication, Shanghai Jiao Tong University, Shanghai 200240, China; rogershc@ms43.hinet.net (S.-H.C.); jzjiang@sjtu.edu.cn or jinzhangphd@163.com (J.-Z.J.)
2   USC-SJTU Institute of Cultural and Creative Industry, Shanghai Jiao Tong University, Shanghai 200240, China
3   Graduate Institute of Environmental Education, National Taiwan Normal University, Taipei 116, Taiwan; kuanchu103@gmail.com (K.-C.W.); faratajiang@gmail.com (Y.-T.C.)
4   School of Business, University of Southern Queensland, Toowoomba, QLD 4350, Australia; eric.ng@usq.edu.au
5   School of Forestry and Resource Conservation, National Taiwan University, Taipei 106, Taiwan
*   Correspondence: d05625002@ntu.edu.tw (C.-H.H.); wtfang@ntnu.edu.tw (W.-T.F.); Tel.: +886-2-7749-6558 (W.-T.F.)

Abstract: This exploratory study aims to fill the gap by adopting Hirose's two-phase decision-making model with the theory of social networks to explore the environmentally friendly attitudes and environmental behavioral intentions toward pro-environmental behaviors of the citizen scientists who participated in the Bird Survey in Taoyuan's Farm Ponds Project. The Bird Survey in Taoyuan's Farm Ponds Project is a systematic citizen science project founded in 2003 with the aim to identify existing and potential irrigation ponds that are important to creating waterbird refuges to secure habitats for wintering waterbirds in anthropogenically influenced areas. The participation in this project itself can be considered as a form of pro-environmental behavior. A total of 24 in-depth semi-structured interviews were conducted with participants of the Bird Survey in Taoyuan's Farm Ponds Project. Qualitative data showed that participants mentioned six variables (i.e., perceived seriousness, ascription of responsibility, belief in the effectiveness, feasibility evaluation, cost–benefit evaluation, and social norms evaluation) of the two-phase decision-making model in relation to environmentally friendly attitudes and environmental behavioral intention. Findings also revealed three key variables (i.e., social networks, learning and growth, and belonging and contribution) in the theory of social networks that are associated with environmentally friendly attitudes and environmental behavioral intention. Based on the findings, it is proposed that the social needs variables are incorporated as an extension to the two-phase decision-making model to offer a more comprehensive explanation of pro-environmental behavior.

Keywords: citizen science; environmentally friendly behavior; pro-environmental behavior; social networking; Taoyuan farm pond bird survey; two-phase decision-making model

1. Introduction

Citizen science refers to the collection of large amounts of data over long periods by the general public across multiple habitats and locations. The contribution of citizen scientists has provided a wealth of data on the occurrence and distribution of species around the world [1]. In recent years, due to the advancement of science and technology and the popularization of geographic information systems, scientific interpretation and investigation are no longer the exclusive domain of scientists, and citizens are being included in the scientific research process at a time of rising environmental citizenship [2].

Citizen science is in a phase of expansion and is increasingly common in the United States and other countries [3].

Scientific exploration and research projects by amateurs have been practiced for many years in the past. The term citizen scientist has been around since the 19th century, mostly used by informal groups of citizens with personal interests or those who are capable of leisure activities [4]. Today, the participation of non-professional citizens in scientific inquiry has become more formalized, with the development of a structured process and organizational model of participation and collaboration between professional scientists and citizen volunteers interested in partial participation in research [5]. This has led to more frequent evaluations and more emphasis on how to advance scientific information and methods of investigation and provide opportunities for participants to learn, understand, and access science [6].

Following the rapid growth of citizen science groups and organizations, the importance and power of local participation in resource monitoring has been recognized, and the benefits of citizen science include improved scientific literacy in the community, increased public support and commitment to conservation and management, greater public participation in the planning and management of local ecosystems, and the collection of usable long-term data at multiple scales [4]. Public participation in scientific research is emphasized for its ability to increase knowledge, scientific literacy, environmental literacy, and the ability to think scientifically [6–9]. This model of citizen science can therefore be a legitimate way for communities and stakeholders to participate in the research process, making it more likely that the general public will be engaged in public policy and political processes [6,10].

The Bird Survey in Taoyuan's Farm Ponds Project is a systematic citizen science project founded in 2003. This project aims to identify existing and potential irrigation ponds that are important for creating waterbird refuges to secure habitats for wintering waterbirds in anthropogenically influenced areas [11]. The project involves volunteers to conduct the required surveys at 45 designated ponds in the Taoyuan Tableland in northwestern Taiwan. The survey period spans from November to February every year when winter migratory birds come to Taiwan. The participation of this project itself can be considered a form of pro-environmental behavior, which refers to any behavior that seeks to protect the environment and ecosystems and duly consider the environmental impacts of specific behavior when making decisions [12].

Although studies about citizen science in various fields and contexts (e.g., sustainable development, health and medical, agriculture, knowledge generation) have been previously explored, few studies have examined the pro-environmental behavior of citizen science participants. This study aims to fill this gap by exploring the environmentally friendly attitudes and environmental behavioral intentions on pro-environmental behaviors of the citizen science who participated in the Bird Survey in Taoyuan's Farm Ponds (TFP) Project.

2. Theoretical Framework and Literature Review

2.1. Two-Phase Decision-Making Model

Hirose [13] considered the process of forming behaviors and proposed that pro-environmental behavior can be explained by a two-phase decision-making model (please see Figure 1). The first phase involves the formation of environmentally friendly attitudes, and the second phase involves various behavioral assessments to determine environmental behavioral intention that will directly or indirectly influence the pro-environmental behavior.

An environmentally friendly attitude refers to "the intent to solve an environmental problem or make a contribution" that supports eco-friendly behavior that is accompanied by a degree of respect for the environment and express concern for ecological issues [14]. It involves three main factors: perceived seriousness, ascription of responsibility, and belief in the effectiveness.
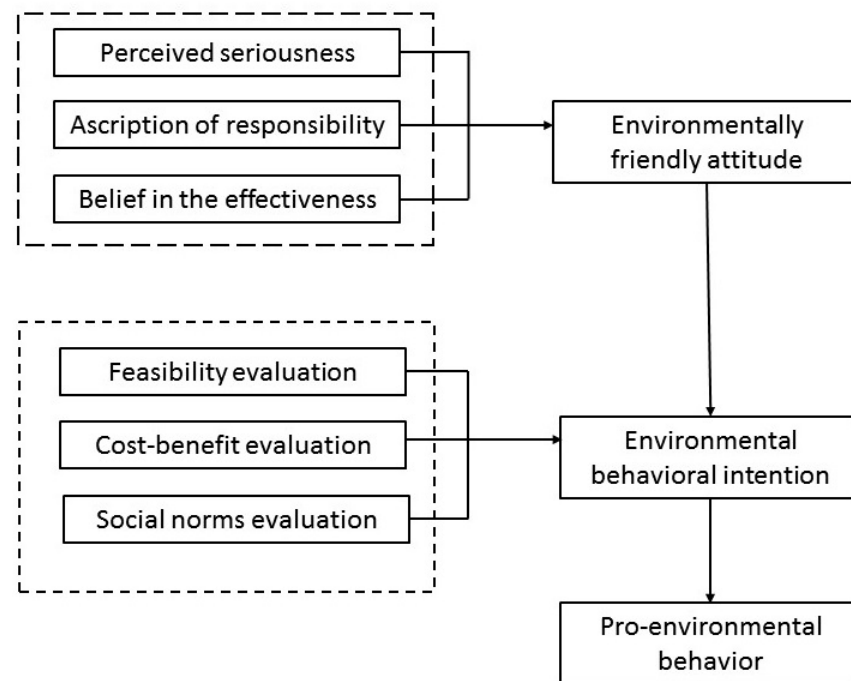
Figure 1. The two-phase decision-making model adapted from Hirose (2015) [13].

Environmental awareness can be subdivided into perceived seriousness of environmental problems and ascription of responsibility, which are split into two variables in the two-phase decision-making model. The perceived seriousness represents the perception of the consequences of environmental problems, while the ascription of responsibility contains the variable of responsibility attribution. The perceived seriousness emphasizes the perception of environmental risk, the severity of environmental pollution, and the likelihood of occurrence, as well as the perceptions and expectations of the likelihood of occurrence of the environmental problem and the severity of the problem [15]. However, individuals may feel that their power is insignificant despite the impact they have on larger-scale problems [16,17].

Ascription of responsibility refers to the recognition of the cause of responsibility, that is, the perception of responsibility, specifically, who or what causes environmental pollution and damage. Although it is easy to attribute the cause of complex environmental issues to natural phenomena, such as water shortages due to the lack of rainfall or energy crises due to the responsibility of government and oil-exporting countries, when it comes to waste disposal, residents often place the blame on themselves, and therefore different actions can be taken to solve environmental problems depending on the responsibility involved. For example, if they blame themselves for environmental pollution, they will try to change their lifestyles in the future. On the other hand, if the responsibility for the problem is attributed to others, they will try to seek compensation for damages, etc. In any case, the stronger the degree of responsibility for environmental problems, the stronger the intention to protect the environment. This ascription of responsibility is also mentioned as a similar concept in educational psychology.

Belief in the effectiveness relates to the recognition of validity of a counter measurement to solve the environmental problem. For instance, a sense of effectiveness can arise if one considers the environmental problem to be solvable by an individual and/or collective efforts of other people. In contrast, if one feels that there will be limited or no effect on addressing the environmental problem regardless of the commitments and efforts put in, then a sense of effectiveness will not substantiate.

On the other hand, environmental behavioral intention refers to the extent to which individuals are willing to consider taking appropriate actions to protect the environment, and this is directly linked to the formation of the target "pro-environmental behavior" [18].

There are three key determinants of environmental behavioral intention: feasibility evaluation, cost–benefit evaluation, and social norm evaluation.

Feasibility evaluation represents the non-economic factors that are considered when determining if it is practicable for one's ability to take on those pro-environmental actions. It also helps to assess if such an opportunity arises to enable an individual to engage in pro-environmental behaviors. This can generally be looked at from both the external and internal perspectives.

The cost–benefit evaluation assesses the benefits of taking pro-environmental actions and the costs involved, for example, a comparison between the complexities of sorting and recycling empty cans and bottles and the investment in products that need to be purchased to save electricity versus the rebate on electricity costs that will result from taking action and the fines that will result from not doing so. The main evaluation criteria for comparing the two are the personal benefit and cost evaluation, such as convenience and comfort. If the reduction in personal benefits and the increase in costs of taking pro-environmental actions are significant, then no action is taken, and vice versa.

Social norm evaluation is the assessment of whether an individual's behavior conforms to the norms and expectations of an organization or society. In the theory of planned behavior, social norm evaluation corresponds to the subjective norm, so the two-phase decision-making model derived from the theory of planned behavior [19] also uses the subjective norm as an assessment item.

Many prior studies about pro-environmental behaviors are primarily based on the influence of knowledge, attitudes, and skills on behavioral intentions [20], which subsequently lead to actual behaviors. However, the two-phase decision-making model suggests that in addition to knowledge, attitudes, and skills, behavioral assessments are needed to determine environmental behavioral intention that will result in pro-environmental behaviors. From previous research, it is evident that social needs such as belonging and connectedness have a strong influence on the efficacy of program participation [21], which is a key element (i.e., the Bird Survey in the Taoyuan's Farm Ponds Project) in this study. Therefore, in addition to the two-phase decision-making model, it is also proposed to include the theory of social networks to be examined in this study.

2.2. The Theory of Social Networks

The theory of social networks has been widely applied and is gaining attention as a new direction in sociological research. The formation of social networks often occurs in the context of cooperative strategies, and the formation of networks is based not only on the demand for resources, but also on social factors of mutual relationships and trust, through which people can obtain relevant information and opportunities [22]. Previous studies reveal that the connection and social needs among the citizen science survey team members may affect the satisfaction and happiness of the participants. Therefore, in addition to analyzing individual behaviors using a two-phase decision-making model, this study also explores the role of social networks in promoting citizen science project teams by understanding the social network relationships among the team members.

A sense of connectedness is defined as the emotion of being connected to others, and the perception of being part of a team and feeling connected to others is a basic human psychological need [23,24]. People are often accustomed to being connected to members of the same team [25]. A strong sense of connectedness to others motivates individuals to strive to be submissive to social groups, to fully fulfill their social roles, and to take actions that promote social harmony and respect social norms [26,27]. A sense of solidarity with others reduces the distinction between self and group [28–30]. This transforms individuals into those with a high sense of connectedness and objectively higher beliefs about group efficacy, which in turn leads to the possibility of transferring to a sense of personal efficacy [31].

The key factor in deciding whether to take socially responsible action is the extent to which they believe their actions can make a difference [32]. Those who are more likely

to connect with others are more capable in establishing their values [33]. To some extent, this may explain the relation between a sense of connectedness and positive socially responsible behaviors [34–37]. Regarding effectiveness, it is also evident that the sense of efficacy is enhanced through connection building and team formation, which corresponds to the belief in effectiveness in the two-phase decision-making model.

From the above-mentioned studies, it is suggested that stronger interpersonal connections will have a positive effect on both individual and collective pro-environmental behaviors. Oriental social culture placed special emphasis on interpersonal relationships. In this context, this study examined the interconnectedness of team members by adding a new variable of the social networks, which had not included in the original two-phase decision-making model, to further explore the influence of connectedness on the continuous participation in the citizen science research project. As a result, a modified model is outlined in Figure 2.

3. Materials and Methods

This study adopted a two-phase decision-making model and the theory of social networks as the framework to explore the pro-environmental behaviors of citizen science participants in the Bird Survey in Taoyuan's Farm Ponds Project. The two-phase decision-making model focused on an individual's environmentally friendly attitudes, and evaluating the behavioral intentions, whereas the theory of social networks was used to explore the connections between the participants and how such a relationship could potentially impact on an individual's pro-environmental behaviors.

3.1. In-Depth Interviews

This study was exploratory in nature, and in-depth interviews were used. An in-depth interview is a conversation between an interviewer and a respondent on a common topic to exchange their perspectives with the aim of constructing knowledge in the process of conversation [38]. As the theory and methodology have evolved into a common research method in social sciences, the researcher uses in-depth interviews to understand the experiences, actions, and underlying meanings of the research subject [38]. If the research question focused on the meaning attached to the experience and the value of the story appeals to the inquirer, then the use of in-depth interviewing techniques would be suitable to help the subject better relate and share the experience [38].

The adoption of in-depth interviews was based on two grounds: collecting interview data and the need for flexibility. Firstly, in-depth interviews were considered one of the more appropriate techniques in exploratory research for collecting inductive data, and since there was limited knowledge about the pro-environmental behavior of citizen science participants, this is an appropriate technique [39]. This method enables the interviewer to gather preliminary information about the research topic and at the same time allows greater insights and understanding [40]. Secondly, in-depth interviews can also provide the flexibility to allow the interviewer to modify, drop, or add propositions in response to evidence from the interviewees [39]. Therefore, the interviewer would be able to acquire a more valuable outcome using this technique.

A total of 24 in-depth interviews were conducted with citizen science participants for the Bird Survey in Taoyuan's Farm Ponds Project from July to September 2017. These interviews were semi-structured in nature and conducted at a location that was convenient to the interviewees. The duration of each in-depth interview was approximately 90 min. The discussion was flexible and informal, thus allowing the interviewer to gain an in-depth understanding of the research topic.

To ensure all required issues were addressed, an interview protocol (Appendix A) was developed and used as a guide in the interviewing process. The interview protocol was structured into three sections comprising several open- and close-ended questions related to the two-phase decision-making model, the theory of social networks, and basic personal

information. The interview protocol was reviewed and checked for appropriateness and accuracy by three experts.

While interviewees were informed, and consent sought for the interview to be recorded for the purpose of verbatim transcription and data analysis, they could also exercise their rights to suspend and stop the recording at any time throughout the interview. When the verbatim transcripts were completed, the interviewees would receive copies of them to confirm the accuracy of the transcribed content.

3.2. Data Analysis Methods

In analyzing the qualitative data, the template analysis style proposed by Crabtree and Miller [41] was adopted. This method has been widely used in many qualitative studies and is characterized by having established categories that also allow open coding. The theoretical basis of this default category list was based on the six variables of the two-phase decision-making model proposed by Hirose [13], with conceptual definitions, operational definitions, and literature for each variable (as shown in Table 1). The coding process also allowed the addition of variables that were not available at the end of the original two-phase decision-making model, so a template-based coding approach was adopted for data analysis. The new codes and the subsequent processing status are presented in Table 2.

In this study, manual coding was used for data analysis. After the initial coding of one or two data contents, these additional codes were organized to serve as a list of codes for the proposed subsequent analysis. This enabled the display of social phenomena, network diagrams between analysis units, and the presentation of personal knowledge maps [42].

Table 1. Category list of default codes.

Category	Variable	Conceptual Definition	Code	Operational Definition	References
Belief in environmental problem	Perceived Seriousness	Perception of environmental changes (environmental awareness, environmental sensitivity, sense of place, important life experiences, sense of vicissitudes)	PS	Speaking about natural experiences, comparison between the present and the past, memories related to the environment, feelings of anger when finding environmental problems, and understanding the natural ecology around us.	[1,5]
Belief in environmental problem	Ascription of Responsibility	Attribution of environmental changes and shocks to human behavior. According to the object of attribution, it is further divided into two categories: internal attribution and external attribution.	AR-I	Internal attribution: attributing the occurrence of environmental problems to my own actions. Speaking of what I should do, my responsibility for it, feeling that it is my responsibility, etc.	[19]
			AR-E	External attribution: attribute the environmental problems to some uncontrollable factors, thinking that the problems are caused by "others" and have nothing to do with oneself. For example, the government and business collusion, the trend of the times, could do nothing about private land.	

Table 1. *Cont.*

Category	Variable	Conceptual Definition	Code	Operational Definition	References
Belief in environmental problem	Belief in the Effectiveness	Considering that participation in the Bird Survey in TFP has an impact on the conservation of birds and the maintenance of habitats in Taoyuan farm ponds, this action is the right remedy to reverse the situation.	BE	Speaking of using survey data to talk to the government, the explanatory power of data, the persuasiveness of evidence, the fact that bird surveys can lead to better ecological conservation, and the fact that doing surveys is a meaningful and useful thing to do.	[34]
Evaluation of behavior	Feasibility Evaluation	The internal and external abilities and conditions that make the surveyor think he or she is capable of conducting the survey without considering economic factors.	FE	It is used to assess whether one has the ability to participate in the survey. For example, the ability to identify birds, the health of the individual, the safety of the survey site, the proximity of the sample area, and the occurrence of unforeseen situations.	[13]
Evaluation of behavior	Cost–Benefit Evaluation	The amount of money, time, manpower, and equipment required and available to participate in bird surveys in terms of economics alone	CBE	Whether the survey time works out? The difficulty of recruiting survey personnel, the length and frequency of time required, the availability of funds, investment in car and gas, the adequacy of survey tools, and the condition of transportation.	[13]
Evaluation of behavior	Social Norms Evaluation	The influence of external social factors on an individual's behavior. Engaging in specific behaviors under the pressure of social influences.	SNE	Influenced by friends and relatives to participate in the survey, because it is an activity of the Wild Bird Society of Taoyuan, as a member of the Society, of course, we must support, go with XX, I quit after friends stopped participating.	[43]

Table 2. Newly added categories after initial coding.

Category	Variable	Conceptual Definition	Code	Operational Definition	References
Social Needs	Social Network	Connected by the flow of information and interpersonal emotions brought about by a closely interconnected network.	SN	Invitation from friends, building connections or revolutionary feelings, meeting new people, having common topics, integrating into a team, finding belonging, feeling needed by others, passing on information	[34,44,45]
Social Needs	Happiness of Sharing	By sharing information and knowledge with friends, relatives and strangers, teaching each other and gaining something.	HS	Various interpretation services (including roving interpretation), participating in elementary school services or outdoor teaching, sharing experiences with rookies during bird watching, sharing beautiful photos	[44]

Table 2. *Cont.*

Category	Variable	Conceptual Definition	Code	Operational Definition	References
Social Needs	Happiness of Growing	Finding oneself growing through overcoming difficulties and moving more and more in the direction one wants to go.	HG	It is hard at the moment, but it is worth it to look back after breaking through the difficulties, to find out that I have changed for the better, and to feel that I have learned something and broadened my horizons after committing myself and feeling satisfied.	[46]
Social Needs	Belief in Altruism	To produce benefits for others through our own efforts or the power of a team.	BA	In order to achieve greater good, individuals are willing to endure a little bit of immediate hardship or inconvenience. When it comes to the sense of honor and contribution of participating in the survey, it does not matter if I work hard, as long as it is helpful in general. If I don't do it, who will do it?	[47,48]
Later incorporated into Ascription of responsibility	Personal Norms	Personal ethical constraints arising from values and beliefs that are not altered by others or by the realities of the environment.	PN	The choice of values, doing it because I think it is important, and not being influenced by others.	[49,50]
Later incorporated into Perceived of Seriousness	Biophilia	Human beings are born with the need to be close to nature and to be in touch with nature.	Bio	The novelty and excitement of seeing rare species, the weird feeling of not being out in the wild, the relaxation and stress relief brought by bird watching, and the desire to go out when sitting in the office for too long.	[51,52]
Later incorporated into belief in the effectiveness	Ecology-related awareness	Through learning and observation, one develops one's own set of definitions and ideas about ecology and produces corresponding behaviors.	Eco	Today's birds are tomorrow's humans, birds are our ecological indicators, and ecological surveys should be done on a long-term basis.	[53,54]

4. Results

4.1. Profiles of the Interviewees

A total of 24 in-depth interviews were conducted, of which 16 were male and the remaining eight were female. The interviewees' ages ranged between 31 to 69, with the majority of them (19 out of 24) having a Bachelor's degree and above education qualification. The average number of years of experience of participating in the Bird Survey in Taoyuan's Farm Ponds Project was approximately five years. Table 3 below presented a summary of the interviewees' profiles.

Table 3. Interviewees' profiles.

Code	Age	Gender	Education Level	Profession	Residence	Years of Survey Experience
Q1	68	Male	Ph.D.	Chair Professor	Taoyuan City	5
Q2	62	Female	Bachelor	Bank Supervisor	Taoyuan City	5
Q3	48	Female	Bachelor	Director of an elementary School	Taoyuan City	3
Q4	52	Male	Master	Chairman of a Biotech Corporation	Taoyuan City	3
Q5	68	Male	Ph.D.	Associate Researcher	Taoyuan City	11
Q6	-	Male	-	-	-	11
Q7	65	Male	Master	Engineering Consultant	Taoyuan City	10
Q8	62	Female	Senior high school	Staff of a trading company	Taoyuan City	6
Q9	57	Male	Bachelor	Elementary School Teacher	Taoyuan City	11
Q10	-	Male	-	-	-	5
Q11	67	Male	Master	Middle School Director	Taoyuan City	9
Q12	65	Male	Doctorate	Researcher	Taoyuan City	7
Q13	54	Male	Associate degree	section manager of a company	Taoyuan City	11
Q14	48	Male	Bachelor	Junior high school teacher	Non-Taoyuan City	0
Q15	49	Male	Master	TV station manager	Taoyuan City	0
Q16	63	Male	Associate degree	Photocopy store owner	Taoyuan City	0
Q17	62	Female	Bachelor	Retired elementary school teacher	Taoyuan City	9
Q18	38	Male	Master	Freelancer	Taoyuan City	2
Q19	31	Female	Bachelor	-	Taoyuan City	1
Q20	55	Male	Bachelor	Information engineer of a foundation	Taoyuan City	1
Q21	69	Female	Bachelor	Retired Junior High School Teacher	Taoyuan City	4
Q22	47	Male	Bachelor	Company Manager	Taoyuan City	2
Q23	64	Female	Bachelor	Retired Junior High School Teacher	Taoyuan City	5
Q24	66	Female	Bachelor	Retired Junior High School Teacher	Taoyuan City	7

"-" denotes the missing information that the respondent preferred not to answer.

4.2. Results of the Two-Phase Model Analysis

Results of the two-phase decision-making model indicated support for the six key variables that affect citizen science's (i.e., participants of the Bird Survey in Taoyuan's Farm Ponds Project) goals and behavioral intentions towards pro-environmental behaviors. The most frequently mentioned variables were perceived seriousness and feasibility evaluation, and they were followed by belief in the effectiveness, ascription of responsibility, cost–benefit evaluation, and social norm evaluation (please refer to Table 4). Finding for each of these variables will be discuss in the following.

Table 4. Frequency mentioned about the six key variables.

Variables	Total Frequency Mentioned (out of 24 Interviewees)
Perceived seriousness	14
Ascription of responsibility	12
Belief in the effectiveness	13
Feasibility evaluation	14
Cost–benefit evaluation	12
Social norm evaluation	12

4.2.1. Perceived Seriousness (PS)

There were 14 (out of 24) interviewees agreed that perceived seriousness could potentially influence their pro-environmental behavior. The majority (12) of these interviewees revealed that they were frustrated and discouraged by the ecological crises such as the deterioration of bird conditions and mud accumulation in the farm ponds. There was also a consensus for urgent actions to be undertaken to address the environmental problems. This was supported by a comment that

"I'm just curious to know what those data can do, I'm curious about that. The data generated by the survey we did, after accumulating, maybe we can have, for example, a decisive impact on the development of the land or on the development of the airport" (Q5)

Eight of the interviewees indicated that farm ponds in the surveyed sites have been through significant changes over the years, which had affected the natural environment. Given the fond memories and close connections to these natural farm ponds of the past, interviewees felt the need for them to take practical environmental actions. An interviewee commented that

"I feel sorry for the things that we saw when we were young. If there is a chance, I also hope that the environment can maintain the kind of human and animal coexistence we used to have, not like now, the whole environment is destroyed, nothing can be seen. Compared to our past, many of those animals can no longer be seen by children today" (Q4)

Six of the interviewees encountered negative nature experiences while conducting their site observation. Among them were the destruction of beloved sites, the disappearance of farm ponds, and environmental pollution. These unpleasant encounters had left the interviewees feeling upset and having grave concerns. Such sentiments were supported by comments such as

"I feel sad. Basically, the pollution in Taoyuan is quite serious, such as the algae reefs, or the beaches with too much garbage to pick up, and many factories are built in areas that should not be built...etc. It is extremely scary that nature is disappearing all the time!" (Q19)

"In recent years, the disappearance of large farm ponds has had a great impact on the habitat of the geese and ducks. The places where we can see geese and ducks have become very rare in Taoyuan" (Q22)

It was agreed by six interviewees that the causes of environmental problems were often complex, and many people tend to oversimplify the causes by attributing them to specific objects and assuming that is the key to solving the problem. Governments and consortia were often regarded by conservationists as responsible for environmental problems because they have the authority to make decisions that impact on the environment. From the government's perspective, some environmental sacrifices were deemed unavoidable to achieve essential economic growth and development. This was supported by an interviewee's comment that

"Conservation groups are often relatively disadvantaged and can only provide ecological data for development reference. In general, pond owners do not care much about birds eating the fish, but the biggest disturbance is the pond improvement by the Taiwan Joint Irrigation Association. Beautification of the pond destroys the ecosystem by spending a lot of money on cementing the pond, which should be told to the relevant authorities" (Q6)

There was a sense of helplessness, as revealed by four interviewees, because the regulations prohibit and limit them in what they could do to protect the environment. They were frustrated with the limited and ineffective actions taken by the government and feared that the seriousness of the environmental problems was being ignored. An interviewee supported this with a comment

"When we went back, the stream was flowing with black water, and there was not a single fish, and no one could do anything about it" (Q4)

4.2.2. Ascription of Responsibility (AR)

Twelve of the 24 interviewees suggested that their pro-environmental behavior could potentially be affected by ascription of responsibility. Ten interviewees revealed that they were powerless as an individual when dealing with environmental problems;

however, this changed when working in a group with an identity. This could be attributed to individuals feeling empowered in a team (e.g., a local bird society) where they could offer support and encouragement to others who shared a common goal in protecting the environment by keeping a close eye on the ecosystem of the farm ponds. This was supported by a comment

> "*Since serving as the chairman of the Board of Directors of the Wild Bird Society of Taoyuan from 1997 to 2011, I deeply feel that farm ponds are the characteristics of Taoyuan. As a local bird society, it is our responsibility to survey and understand the birds of farm ponds and to establish long-term information for subsequent application when necessary*" (Q5)

Furthermore, eight interviewees indicated that being a part of the team had given them a sense of responsibility and motivation to influence others around them about environmental issues. A comment provided by an interviewee supported this opinion:

> "*The historical mission of the farm ponds may be changing, but it is our duty to provide winter migratory birds a satisfactory winter habitat*" (Q20)

4.2.3. Belief in the Effectiveness (BE)

Of the 24 interviewees, 13 of them felt that belief in the effectiveness could potentially impact on their pro-environmental behavior. Ten interviewees indicated that the underlying reason for their participation in the Bird Survey in Taoyuan's Farm Ponds Project was driven by the fact that they believe a better understanding of the environmental problems would help them to identify more effective solutions. Thus, the collection of basic ecological research data over a period of time was considered as an essential part of achieving this. An interviewee commented that

> "*Long-term survey data, together with landscape changes, can reveal the impact of landscape changes on bird ecosystems, so that specific evidence can be presented during the evaluation of new development projects to determine the extent of ecological impacts so that development projects can be canceled or modified to protect local ecological resources*" (Q22)

Although nine of the interviewees were aware that certain farm ponds had very few birds visiting over the years, they had continued conducting their survey on these sites because of the need for on-going data collection and sampling. An interviewee supported this by commenting

> "*Because it is scientific, with random sampling, so scattered throughout the Taoyuan. For example, there could be five ponds here, and one of them has a rich ecosystem, but this means nothing if it is not sampled. Research must be persistent, even though there are no birds*" (Q4)

Six interviewees knew the importance of long-term research data collection because of their educational background, while others (seven) learned through their many years of experiences with the bird society activities. Thus, they would continue to participate in this survey to ensure that the ecological data could be collected and helped identify effective solutions to the environmental problems. This was supported by an interviewee's comment:

"I joined the bird society because of my passion for birds, and my concern for the environment and biomedical training. I am aware of the importance of long-term surveys and the recording of relevant information. I usually make records of bird watching and try to upload the relevant bird survey record system. Therefore, when fellow birdwatcher XXX (a person's name) first promoted this idea and project, I fully supported and participated in it" (Q12)

Furthermore, six interviewees revealed that their learnings through participating in surveys had slowly been internalized to become an opinion. This was supported by an interviewee's comment:

"This is very important for the protection, preservation, and conservation of farm ponds, and is a very important indicator, especially for the winter migratory birds to farm ponds; we give them 800 m^2 of land for them to move around" (Q22)

Some interviewees (five) had also suggested that the longitudinal data collected could be used as evidence to support any initiatives and solutions that aimed at addressing the environmental problems, especially in the Taoyuan region. This was supported by an interviewee's comment:

"With such a rich amount of data, it is possible to negotiate with the Taoyuan City Government or the relevant engineering division of the Taiwanese Construction and Planning Agency beforehand to find a balance between ecology and engineering" (Q18)

4.2.4. Feasibility Evaluation (FE)

There were 14 interviewees (out of 24) who agreed that feasibility evaluation played an essential role in influencing their pro-environmental behavior. The majority of these interviewees (11) highlighted the importance of safety in conducting the Bird Survey in Taoyuan's Farm Ponds Project. When safety was compromised during the conduct of the survey, participants would withdraw from continuing because of the danger involved. This was supported by an interviewee's comment:

"Dogs are a means to prevent theft in many farm ponds, but for those of us who perform bird surveys, it is a problem for us to maintain our personal safety, and we often put ourselves in dangerous situations while carrying out bird surveys" (Q20)

The need for better protections (such as insurance, gears) was considered by many interviewees as important to carry out their survey activities safely and at the same time beneficial (e.g., reduce liability) to the organizer hosting the survey project. An interviewee supported this with a comment:

"Especially for those who use volunteers, no matter what they are going to do, insurance is the first thing that matters. (Insurance.) Because we go to sweep the streets, to clean the beach, to save the birds, which involves a lot of risks. If you don't have insurance, it's okay if nothing happens, but when something happens, you can't explain it to the families" (Q3)

In addition, eight interviewees mentioned that the environmental constraints of the survey sites could present access difficulties to the farm ponds, which were caused by cold wind and rainy weather. In addition, the area to cover for some survey sites was enormous and posed a significant challenge to participants. This was supported by an interviewee's comment:

"In the beginning, I was in charge of five farm ponds, and they were all very large in size, so it took two days to finish each time. After two years, I finally couldn't take it anymore and had to drop two ponds in Xinwu, so I was more willing to continue" (Q4)

Factors affecting the capability to conduct the Bird Survey in Taoyuan's Farm Ponds Project were also raised by seven interviewees. These interviewees agreed that they joined the bird society and participated in conducting the survey after their retirement while they were still physically fit and healthy. However, as the years passed by, they got older and

experienced health issues that began to prevent and limit their participation in the survey activities. This sentiment was support by an interviewee's comment:

"Because I like bird watching and I am a member of the Wild Bird Society of Taoyuan, I am happy to contribute to the bird watching community. Now that I am old, I still like bird watching, but I am not physically able to do more" (Q21)

Furthermore, the Bird Survey in Taoyuan's Farm Ponds Project required participants to have an adequate level of specialized skills and knowledge (e.g., bird watching and identification) to conduct the survey. An interviewee commented

"I was first encouraged by fellow bird watchers. After all, I was a little better than the average person at that time in bird-watching skills. I could tell what kind of bird it was by ear and by sight. They encouraged us to participate in some surveys. Because, if you do not have good identification ability, you will be confused" (Q22)

Six interviewees stated that there were other factors such as obligations (e.g., career commitments, carer's duties) in life that made it difficult if not impossible to participate in the Bird Survey in Taoyuan's Farm Ponds Project. Such considerations were necessary for many people to help determine if they could accomplish the survey activities. This was supported by an interviewee's comment:

"And parents can't participate if their children are too young. Our children were young at that time and we had no, also could not . . . find (time). Although the bird society was established, we cannot regularly attend their activities except the bird watching season organized by them. (Maybe they can attend big events, the kind where you can bring your family)" (Q21)

4.2.5. Cost–Benefit Evaluation (CBE)

Twelve of the 24 interviewees agreed that cost–benefit evaluation could have a potential effect on their pro-environmental behavior. Time factor was a major consideration by 10 of these interviewees when participating in the Bird Survey in Taoyuan's Farm Ponds Project. This was particularly evident when changes to the survey schedule were required by the organizer, since participants could have other prior commitments (e.g., related to family, personal, and work) that would prevent them from accommodating such changes in schedule. This could result in unnecessary stress on the participants while they attempted to make any possible adjustments to their other commitments. An interviewee commented

"In recent years, I have been busy with my personal affairs and have been less involved in bird society activities. However, as long as the coordinator of the project sends me a letter, I am willing to exclude other matters and continue to participate" (Q12)

When a participant was to conduct the survey independently, he or she only needed to consider his or her availability, and it was simple to organize. On the other hand, when some participants chose to conduct the survey in groups, some levels of coordination between them were required, and this would include the complications involved in scheduling the survey and tasks. However, it was acknowledged that there were benefits in a group survey approach that included mutual support, learning, sharing of experience, and knowledge. This was supported by an interviewee's comment:

"It is a little difficult for different partners to coordinate their time, but sometimes it can be a happy gathering for partners with the same interests" (Q6)

Seven interviewees indicated that the travel distance to the survey sites was another factor that affected their participation in the Bird Survey in Taoyuan's Farm Ponds Project. The travelling time and costs to far away survey sites could result in participants withdrawing from conducting the survey. Comments provided by interviewees supporting this included:

"At the beginning of the farm pond survey, there were five of us, and XXX (a person's name) would drive us because we all lived very far away" (Q13)

"The volunteers could choose the ones near their homes first. Then the ones that were far away and had not been picked still need to be surveyed. It was not very convenient for some people, like those who had to ride motorcycles" (Q6)

A lack of manpower to conduct the survey was also raised by five interviewees, since this would increase the workload and caused an additional burden and distress to other participants. Since participants required specialized skills and knowledge, it had been difficult to recruit people with suitable skill sets. An interviewee supported this with a comment:

"Things that are particularly difficult or troublesome: (1) coordinating new participants to join when surveyors change; (2) each survey requires notifications in advance, but also individual telephone follow-ups to ensure that staff do not forget and can complete the bird survey according to the deadline. Factors that can dampen enthusiasm: (1) un-suitable personal physical conditions; (2) inability to find enough birders to help with the survey" (Q5)

4.2.6. Social Norm Evaluation (SNE)

A total of 12 (out of 24) interviewees indicated that social norm evaluation was considered influential to their pro-environmental behavior. Eight interviewees stated that the perceptions and support of friends and relatives would influence their participation in the Bird Survey in Taoyuan's Farm Ponds Project. Inputs from family members and friends were regarded as a personal influence of significant others around them, which was also a key reason to many participants joining the bird-watching community in the first place. An interviewee's commented:

"When my family learned that I was conducting the Bird Survey in TFP, they gave me positive support and encouragement, and XXX (a person's name) and I had a lot of fun participating in the survey, especially when we had unexpected observations. I often saw winter migratory birds that I would not normally observe. During my own observation, I also found out the importance of Taoyuan farm ponds to the habitat of winter migratory birds. Such meaningful activities are the motivation for continuous participation in the survey" (Q20)

The scope of this influence of significant others also included large community groups such as the bird society, which further extended the circle of friends to the people in the bird-watching community. A comment by an interviewee support this:

"I joined the Taoyuan bird because of my wife who joined first and asked me to be the driver for bird watching trips, and after going with her many times, I also became interested in bird watching and stayed. After that, I helped in the bird society, and after many times participating in activities, all my friends were bird watchers, so I just became inseparable from the group" (Q7)

In contrast, four interviewees argued that they had developed a sense of responsibility, attitude, and principle of environmental protection and therefore felt that it was personal when relating to environmental problems. As such, they participated in the Bird Survey in Taoyuan's Farm Ponds Project because it was a personal and worthwhile activity to pursue, regardless of others' opinions. This was supported by an interviewee's comment:

"The decision to participate in the survey is personal, and I could conduct the survey independently. Therefore, the reaction of friends and relatives or how the survey partners interact with each other will not affect my decision to continue to participate in the survey project" (Q22)

4.3. Results of Theory of Social Networks

Findings from the theory of social networks showed evidence of influence on the participation of the Bird Survey in Taoyuan's Farm Ponds Project. The results identified three key variables: (1) social networks, (2) learning and growth, and (3) belonging and

contribution, and each of these will be discuss in the following. Table 5 below presented the frequency mentioned on these three variables.

Table 5. Frequency mentioned about the three key variables.

Variables	Total Frequency Mentioned (out of 24 Interviewees)
Social networks	17
Learning and growth	12
Belonging and contribution	11

4.3.1. Social Networks

There were 17 (out of 24) interviewees who agreed that social networks could potentially affect their pro-environmental behavior.

Personal symbol and feature. There was a sense from 11 interviewees that bird watching had become a personal symbol and feature. This was evident when colleagues, relatives, and friends began to regard them as the person to go to for questions related to birds, and this had added a new identity and character to their existing interpersonal network. In this process of sharing and helping others with their knowledge, individuals had expanded their interpersonal network. This was supported by an interviewee's comment:

> "*When I attended the elementary school reunion, I couldn't even remember things from the past or the names of my classmates, but I was able to get everyone to listen to me and become the focus (yes, the focus) in that table. Yes, because what I said was very interesting*" (Q4)

Further to the friendships developed within the bird society, eight interviewees had also expanded their acquaintance with residents near the farm pond sites they surveyed. Residents shared with the participants in the Bird Survey in Taoyuan's Farm Ponds Project about the latest information and engaged closely with them to monitor environmental issues. An interviewee supported this with a comment:

> "*In the past, our Chairman O used to send gifts and fruits to the residents during the three major festivals. In fact, most of our gifts were fruits, because we cooperated with many small farmers and bought their fruits to give to these villagers. So the villagers' perception of our bird society is quite positive. Sometimes when there is fishing by electricity or poison, digging roads, or cutting trees, they will inform us*" (Q13)

Six interviewees revealed that they often came across visitors and hikers who are non-local residents at the survey sites, asking them questions related to the Bird Survey in Taoyuan's Farm Ponds Project. Interviewees were confident in sharing their knowledge and experiences as a result of their on-going participation in this project, especially with the support of the evidence-based survey data collected over the years. This was supported by a comment by an interviewee:

> "*After long-term participation, besides the increase in the number of wild bird species I have seen, I have also become curious about why the species and number of birds have changed, and I am concerned about the ecological changes around me. Besides, if we encounter tourists or hikers expressing curiosity or interest in wild birds during the survey, we will explain them briefly, hoping to take this opportunity to arouse their interest and increase their liking for the natural world*" (Q12)

Power of commitment. While seven interviewees indicated that there was pressure toward their ongoing commitment to participate in the Bird Survey in Taoyuan's Farm Ponds Project, it was a sense of self-responsibility and trust in others that kept them going. Having seen the mutual commitments made towards one another, five interviewees considered their participation in the survey as a mission that must be accomplished. This was supported by an interviewee commenting that

"No one came to check if you were doing it properly, but I still spent the full 30 min. Yes, that's my recognition and expectation for myself" (Q18)

Personal social networks connection. Despite the increasing use of electronic communication via email, social media platforms (e.g., Facebook), and Apps (e.g., Line), 13 interviewees recognized the need for more personal connections with their social networks as part of the Bird Survey in Taoyuan's Farm Ponds Project. Eleven interviewees agreed that telephone calls and face-to-face communication would give them a sense of being valued and treated as a valuable individual rather than merely a tool for data collection. An interviewee supported this with a comment:

"So, like the Breeding Bird Survey Taiwan (BBS), they are very thoughtful, will always call. XXX (a person's name) will also use the phone and will not simply send an email or a text message to tell you to go and survey. So, I think that, as the saying goes "meeting in person leaves a better impression," personal contact is helpful, is really helpful" (Q20)

Therefore, attending the various activities (e.g., bird-watching competitions) organized by the bird society would provide opportunities for participants to stay in touch with one another. Some interviewees (six) also indicated that they would feel uncomfortable being left out of such activities, since they valued the opportunity to catch-up with their friends who shared a common interest. This was supported by an interviewee's comment:

"So, we will get together after the survey and chat, bonding with each other is also very good. In that kind of atmosphere, because if everyone but you in the bird society had participated in the survey, you would not have a common topic to chat with others, you would feel that it's quite a pity" (Q17)

4.3.2. Learning and Growth

Of the 24 interviewees, 12 of them revealed that their learning and growth could potentially affect their pro-environmental behavior.

Craving for knowledge drives continued participation. Ten of these interviewees who became involved in citizen science projects came along with an established cognitive concept. Many of them wanted to learn something new in terms of knowledge and skills from a team led by an expert in the field. An interviewee commented:

"In fact, I first wanted to learn a technique that I would not have sought out when I was watching birds in the past. Then when I saw others with us, then they would use their way that I would be curious in this material, because after all, such way of observation is more scientific, and engineers like me prefer scientific observations, which are quantitative in nature" (Q22)

Six interviewees revealed that they first began to be involved in the Bird Survey in Taoyuan's Farm Ponds Project because of the opportunity to see certain bird species, but this had gradually changed to environmental concerns for the ecological issues. This was a result of their accumulated knowledge and experience gained from the participation in the survey that had transformed their perspective of the environment. However, they believed that there was much more to explore and learn in this space, which was another driver for their continual participation. This was supported by an interviewee's comment:

"I think we can learn a lot from this, so we can observe birds in a more detailed way. Then you will learn how wild animals are like humans when they are injured and what the environment is like. I think it is quite special to learn some different knowledge other than bird watching" (Q12)

Satisfaction in the process of pursuing breakthroughs. Eight interviewees commented that they initially joined the Bird Survey in Taoyuan's Farm Ponds Project to seek improvements on their photography skills, but were soon exposed to other tasks and activities that challenged their abilities. Their personal development in this process had enabled them to become a better person in life. This was supported by an interviewee's comment:

"Bird Survey in TFP is to maintain a better environment for the birds in farm ponds. Although there have been obstacles and difficulties, after overcoming them one by one, we feel that we have gained a lot and are happy to do so" (Q20)

For five other interviewees, their participation in the Bird Survey in Taoyuan's Farm Ponds Project was motivated by serving others and enjoying the process of helping them to grow and change to become a better person. This gave them a sense of personal accomplishment and giving back to the community. An interviewee support this by commenting that

"This is what motivates volunteers. Volunteers are not in it for the money, they mostly do it for a sense of honor or as a mission to the community" (Q11)

4.3.3. Belonging and Contribution

There were 11 interviewees (out of 24) who indicated that belonging and contribution could potentially influence their pro-environmental behavior.

Individuals' sense of contribution to the whole. Seven interviewees agreed that a key motivation for them to continue with the Bird Survey in Taoyuan's Farm Ponds Project was recognition from their peers in the bird society. Being able to offer support and contribute to the group had made them feel like a valued member. This sentiment was supported by interviewees' comments:

"I feel that it was a very meaningful effort to contribute, although small, to the protection of the ecological environment" (Q24)

"It was also birdwatching. But one has to make a record and at a fixed time, at a specified place and time. Although this is more constrained for me, the sense of honor and being needed can be enough to compensate for my (efforts)" (Q14)

Gaining recognition by sharing with others. Four interviewees suggested that they should disseminate the results of the data collected to a wider group of audiences so that more people could learn about birds and better understand the need for habitat protection and conservation. This could be regarded as an environmental education effort to enhance the level of environmental literacy. A comment by an interviewee supported this:

"We will work together with local schools to educate people about the environment. The so-called personal action is to start by oneself and share it with colleagues and friends around us, to change people' mindset" (Q3)

5. Discussion

Social psychologists had found that people often joined a team or group where they could gain both affiliation and a sense of belonging. Groups provided individuals with a source of information, recognition and encouragement, and support in achieving goals. The goals included the concepts of access to information, self-identity, values, attitudes, and accepted behaviors [55]. In a group setting, not only could individuals influence others, but they could also be gradually influenced by members in the team.

5.1. Access to Information through Connections

Preece and Ghozati [56] classified community conversations into five main categories, namely (1) health, (2) personal interests (hobbies), (3) pets, (4) careers, and (5) sports and recreation. In the case of this study, the information shared among the participants was mostly about birds, and the exchange of information within the community was very active. Sharing was a powerful experience for both the sharers and the recipients of information. In particular, the sharing of information in a common social network not only transmitted information, but also strengthened the value of sharing among the peers.

Compared with traditional social groups, virtual communities were "weak links", i.e., relationships in which people could obtain useful information from acquaintances or strangers through networks [57]. Weak connections had more opportunities to play a linking

role across domains than strong connections such as kinship and work relationships [58,59], providing people with access to relevant information and opportunities [22,60].

Access to information had a great impact on the participation in the Bird Survey in Taoyuan's Farm Ponds Project. The survey had been conducted for many years and had gone through many staff changes and rotations and suspension of surveys. As a result of these changes and a lack of appropriate communication, some participants did not continue to participate in the survey [61]. Furthermore, as the Bird Survey in Taoyuan's Farm Ponds Project was a systematic citizen science project, the original survey sample sites were limited, thus limiting new participants joining and contributing to this survey. Consequently, some existing participants had to withdraw from this survey to allow new blood to join in and attain sustainable continuity of the Bird Survey in Taoyuan's Farm Ponds Project.

5.2. Formation of Personal Norms after Interaction with Others

According to social identity theory, people form social identities in terms of values, attitudes, and behavioral intentions from different self-identified members [62,63]. A person's self-identity is generally derived from past membership in a social group, which could be an occupational corporation or a society formed for interests and hobbies [64,65]. The rapid and intensive sharing of images and information through social media created social and personal norms and attitudes. The interconnectedness of social media allowed individuals to have quick access to the behavior of others, and this exchange of information influenced the norms and behaviors of individuals [66–68].

Driven by the individual's innate need to integrate into the larger group, a normative effect was formed so that everyone does the same thing, and it seemed unjustifiable if one does not follow suit [69]. Therefore, if we look at it from a two-phase decision-making model, this social demand had an impact on both the first phase of developing an environmentally friendly attitude and the second phase of generating environmental behavioral intentions.

Similar concepts were also mentioned in the interviews from the participants of the Bird Survey in Taoyuan's Farm Ponds Project. They had committed to the survey because it was important to them personally, and the opinions of others were not critical. This finding differed from some prior literature that revealed the importance of social norms and other people's perceptions, particularly in the Asian context. This could be explained with many participants agreeing that their ongoing participation in the survey was mainly motivated by wanting to help for a good cause. Therefore, the results suggested that social norms would affect the initial phase of participation but were less influential after personal norms were formed.

5.3. Feelings Are Necessary to Generate Environmental Action

5.3.1. Influence of Emotion on Actions

The power of feelings played an important role in human behavior, usually through the way people think and behave [70]. Previous studies had found that emotions such as affinity, love, empathy, sympathy, anxiety, anger, and sadness influence pro-environmental behaviors [44,46,63,64,71], while a lack of feelings might lead to indifference [44,65]. Kals, Schumacher, and Montada [63] suggested that these feelings would create psychological fluctuations, and that even if they perceived the current course of action was not significant, this psychological disquiet could motivate people to take action or change on an ongoing basis.

The two-phase decision-making model began with perceived seriousness, which had a catalytic role in the awareness of the natural environment. Although some participants of the Bird Survey in Taoyuan's Farm Ponds Project started bird watching as a hobby, the various environmental problems that some people came across while conducting the survey at the farm ponds sites had left a deep impression on them. Such a deep awareness of the environment had also motivated them to make accommodations (e.g., change original

scheduled dates to better suit the birds' habits) subsequently to ensure they would have a rich birdwatching experience.

The findings indicated that before these nature experiences, some participants of the Bird Survey in Taoyuan's Farm Ponds Project had no special feelings about birds and thus did not pay attention to related issues. Initially, they were focused on the "visible" results, such as increasing the number of bird species they saw and photo taking. However, over time, they realized the ecological significance and importance of birds, and other "inner" transformation results, which might have changed one's behavior.

5.3.2. Sharing Gives Meaning to Feelings

Feelings about nature had a positive effect on pro-environmental attitudes and behaviors, but for one's feelings about nature to mature, one must communicate and share these experiences about nature with others [54,62]. The process of transmitting nature experiences played an important role in emotional development because it was how individuals deconstructed and found meaning in their interactions with nature [65]. Previous research had found a correlation between the degree of increased feelings about nature and the amount of time people spend in nature and whether they shared their values and enjoyed the experience with their family and friends [72]. Results of this study suggested that participants of the Bird Survey in Taoyuan's Farm Ponds Project built a sense of human connection by sharing and talking with each other about their experiences, observations, and feelings in the natural environment [73]. At the same time, they were seen as helpful to others in their established interpersonal circles when they shared their newly learned knowledge.

In the two-phase decision-making model proposed by Hirose [13] to explain the generation of pro-environmental behaviors, the first phase of developing environmentally friendly attitude was divided into three types of beliefs: perceived seriousness, ascribed responsibility, and belief in the effectiveness. Many of the shared information contents would fall under the category of perceived seriousness in this two-phase decision-making model [13]. Typhina [44] suggested that the richness and complexity of the feelings between humans and nature that individuals developed when they communicate with others were more important than the relationship between individuals and nature and that this need to communicate with others went beyond biophilia, which was based on biocompatibility.

Up until recent years, many reports and articles were produced from the Bird Survey in Taoyuan's Farm Ponds Project that were beneficial to various stakeholders (e.g., bird enthusiasts, general public, government agencies). However, this had changed lately with limited information published that included only the number of bird species recorded for the year. This indicated that the Bird Survey in Taoyuan's Farm Ponds Project appeared to be less active in sharing information and survey results. Consequently, participants considered the survey to be a task in which they could contribute towards a noble mission of protecting the environment rather than a hobby.

5.4. Extended Two-Phase Decision-Making Model

Based on the results of this study, the application of the two-phase decision-making model could be extended to include the variables of social needs to explain citizen science engagement behaviors. The three influencing variables of social needs were social networks, learning and growth, and belonging and contribution. The results indicated that both the development of an environmentally friendly attitude in the first phase and the series of behavioral assessments generated in the second phase were influenced by the social needs. Therefore, an extended two-phase decision-making model to incorporate the variables of social needs was proposed, as shown in Figure 2. While this proposed modified model (Figure 2) had not been specifically tested in this study, it could be used for further investigation in future studies.
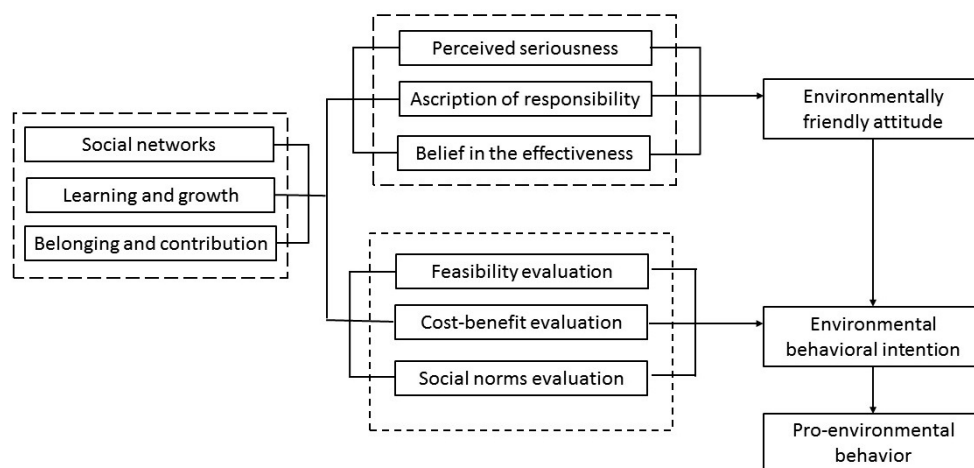
Figure 2. Extended two-phase decision-making model with social needs (based on the results of this study).

6. Conclusions

In conclusion, this study had used an extended two-phase decision-making model that incorporated social needs to explore the impact of environmentally friendly attitudes and environmental behavioral intentions on pro-environmental behaviors with the citizen scientists who participated in the Bird Survey in Taoyuan's Farm Ponds (TFP) Project. The two-phase decision-making model began with an understanding about the development of environmentally friendly attitudes of the participants and subsequently evaluating their environmental behavioral intention that led to their on-going participation in the Bird Survey in Taoyuan's Farm Ponds (TFP) Project, which was considered a form of pro-environmental behavior.

Findings revealed that participants recognized the seriousness of the environmental problems when they were exposed more to and had a better understanding of the nature. The study also found that participants were more aware of their responsibility towards making positive changes to the environment and believe that working in co-operative teams would be more likely to produce effective solutions to the environmental problems. Results showed that participants contributed to the group as a whole and learned new knowledge and skills that they would not otherwise normally have access to. While sharing what they had learned and seen, they also offered some new meanings and dimensions to these experiences and knowledge, thus creating an empowering effect. It had also been noted in this study that participants who participated in the Bird Survey in Taoyuan's Farm Ponds (TFP) Project had acquired a form of self-identity associated with the team, which led to their increasing commitment to the bird society's activities. These findings could assist in the development of appropriate promotion and recruiting campaigns to encourage more participants to join community groups as well as volunteer in citizen science and pro-environmental behavior projects. Furthermore, relevant educational workshops could also be designed and conducted for the public to enhance their general environmental knowledge literacy and understanding.

There was evidence from this study to indicate the occurrence and effects of social networks and needs in the two-phase decision-making model. Thus, the two-phase decision-making model that incorporated the key variables (i.e., social networks, learning and growth, and belonging and contribution) of social needs had provided a more comprehensive understanding about the citizen science participation behaviors.

7. Limitations and Future Research
7.1. Limitations of the Research Methods

This study used qualitative in-depth interviews to collect data, and therefore the results cannot be generalized. This qualitative approach is also not capable of analyzing the regressions and differences of the participants' participation in the Bird Survey in

Taoyuan's Farm Ponds (TFP) Project. Although the frequency of the mentioned categories might serve as an indicator of importance, it was deemed inappropriate in this study, since the number of interviewees involved was inadequate where meaningful explanations could not be attained.

The recruitment and training of participants for the Bird Survey in Taoyuan's Farm Ponds (TFP) Project were mainly conducted through the Wild Bird Society of Taoyuan. Therefore, it is not possible to distinguish whether the close interaction and connection between the participants were caused by joining the Wild Bird Society of Taoyuan or by participating in the citizen science project.

7.2. Limitations of the Scope of Inferences from the Study Results

Due to the purposeful sampling adopted, participants who had participated in the Bird Survey in Taoyuan's Farm Ponds (TFP) Project from 2003 to 2016 were chosen as the study subjects, and the sample size was relatively small. The context of this study has limited to the Bird Survey in Taoyuan's Farm Ponds and in the location of Taiyuan, Taiwan, and therefore the findings cannot be generalized to other themes and the general population at large in Taiwan or other parts of the world.

7.3. Future Research

A more representative sampling of the population is required to seek generalization. Furthermore, similar studies (including other types of citizen science projects) can be conducted in other parts of Taiwan and other countries so that a cross comparison between countries can be made to investigate any potential similarities and differences. Future studies can also consider using the proposed extended two-phase decision-making model to investigate the environmentally friendly attitudes, behavioral intention, and pro-environmental behaviors and verify the appropriateness of this modified model.

Appendix A

Table A1. Semi-structured in-depth interview questions and the connections between pre-defined variables in the two-phase decision-making model of the study.

No.	Question	Predefined Variable
1.	Have you participated in the survey every year since 2003? If you have not participated in any of the survey years, please list them and briefly explain why.	Ascription of responsibility, Motivation for participation, Belief in the effectiveness, Cost–benefit evaluation, Social norm evaluation
2.	Please briefly describe how you first joined the team and what motivated you to join? As your participation has increased, what are the reasons and motivations that drive you now? Has it changed?	Perceived seriousness
3.	What do you think about the disappearance of farm ponds, given the rapid development of the Taoyuan area? Does the opening of the airport MRT have any effect on the condition of the birds?	Ascription of responsibility, Motivation for participation
4.	What do you personally think is the importance of the annual Bird Survey in TFP to the protection of birds in the farm ponds in Taoyuan?	Belief in the effectiveness
5.	What do you think is the greatest personal gain from participating in the survey program? (Or the most fulfilling event or impressive memory)	Belief in the effectiveness, Cost–benefit evaluation
6.	What have you found particularly difficult or troubling about participating in this survey project from the beginning to the present? What circumstances or reasons have dampened your enthusiasm or made you feel discouraged?	Belief in the effectiveness, Cost–benefit evaluation,
7.	Do the reactions and opinions of your friends and relatives about your participation in the bird survey and the way you interact with your survey partners influence your decision to continue to participate in the survey project? Why?	Social norm evaluation
8.	How do you think the fruitful survey results over the years can be useful for conservation in the future? What specific actions do you personally take to protect the birds and ecological environment of Taoyuan farm ponds?	Feasibility evaluation, Belief in the effectiveness
9.	What do you imagine or expect for the future of this survey project?	Feasibility evaluation, Belief in the effectiveness

References

1. Dickinson, J.L.; Shirk, J.; Bonter, D.; Bonney, R.; Crain, R.L.; Martin, J.; Phillips, T.; Purcell, K. The current state of citizen science as a tool for ecological research and public engagement. *Front. Ecol. Environ.* **2012**, *10*, 291–297. [CrossRef]
2. Miller-Rushing, A.; Primack, R.; Bonney, R. The history of public participation in ecological research. *Front. Ecol. Environ.* **2012**, *10*, 285–290. [CrossRef]
3. Bonney, R.; Cooper, C.; Ballard, H. The theory and practice of citizen science: Launching a new journal. *Citiz. Sci. Theory Pract.* **2016**, *1*, 1. [CrossRef]
4. Silvertown, J. A new dawn for citizen science. *Trends Ecol. Evol.* **2009**, *24*, 467–471. [CrossRef]
5. Dickinson, J.L.; Zuckerberg, B.; Bonter, D.N. Citizen science as an ecological research tool: Challenges and benefits. *Annu. Rev. Ecol. Evol. Syst.* **2010**, *41*, 149–172. [CrossRef]
6. Haywood, B.K. Beyond data points and research contributions: The personal meaning and value associated with public participation in scientific research. *Int. J. Sci. Educ. Part B* **2016**, *6*, 239–262. [CrossRef]
7. Hsu, C.-H.; Lin, T.-E.; Fang, W.-T.; Liu, C.-C. Taiwan Roadkill Observation Network: An example of a community of practice contributing to Taiwanese environmental literacy for sustainability. *Sustainability* **2018**, *10*, 3610. [CrossRef]
8. Hsu, C.-H.; Chang, Y.-M.; Liu, C.-C. Can Short-Term Citizen Science Training Increase Knowledge, Improve Attitudes, and Change Behavior to Protect Land Crabs? *Sustainability* **2019**, *11*, 3918. [CrossRef]
9. Jordan, R.C.; Gray, S.A.; Howe, D.V.; Brooks, W.R.; Ehrenfeld, J.G. Knowledge gain and behavioral change in citizen-science programs. *Conserv. Biol.* **2011**, *25*, 1148–1154. [CrossRef]
10. Overdevest, C.; Orr, C.H.; Stepenuck, K. Volunteer stream monitoring and local participation in natural resource issues. *Hum. Ecol. Rev.* **2004**, *11*, 177–185.
11. Hsu, C.-H.; Chou, J.-Y.; Fang, W.-T. Habitat selection of wintering birds in farm ponds in Taoyuan, Taiwan. *Animals* **2019**, *9*, 113. [CrossRef]

12. Steg, L.; Vlek, C. Encouraging pro-environmental behaviour: An integrative review and research agenda. *J. Environ. Psychol.* **2009**, *29*, 309–317. [CrossRef]

13. Hirose, Y. Two-phase decision-making model of environmental conscious behavior and its application for the waste reduction behavior. *Saf. Sci. Rev.* **2015**, *5*, 81–91.

14. Laroche, M.; Toffoli, R.; Kim, C.; Muller, T.E. The influence of culture on pro-environmental knowledge, attitudes, and behavior: A Canadian perspective. *ACR N. Am. Adv.* **1996**, *23*, 196–202.

15. Renn, O.; Burns, W.J.; Kasperson, J.X.; Kasperson, R.E.; Slovic, P. The social amplification of risk: Theoretical foundations and empirical applications. *J. Soc. Issues* **1992**, *48*, 137–160. [CrossRef]

16. Jackson, T. Motivating sustainable consumption. *Sustain. Dev. Res. Netw.* **2005**, *29*, 30–40.

17. Stoll-Kleemann, S.; O'Riordan, T.; Jaeger, C.C. The psychology of denial concerning climate mitigation measures: Evidence from Swiss focus groups. *Glob. Environ. Chang.* **2001**, *11*, 107–117. [CrossRef]

18. Yoon, A.; Jeong, D.; Chon, J. The impact of the risk perception of ocean microplastics on tourists' pro-environmental behavior intention. *Sci. Total Environ.* **2021**, *774*, 144782. [CrossRef]

19. Ajzen, I. The theory of planned behavior. *Organ. Behav. Hum. Decis. Process.* **1991**, *50*, 179–211. [CrossRef]

20. Liang, S.-W.; Fang, W.-T.; Yeh, S.-C.; Liu, S.-Y.; Tsai, H.-M.; Chou, J.-Y.; Ng, E. A nationwide survey evaluating the environmental literacy of undergraduate students in Taiwan. *Sustainability* **2018**, *10*, 1730. [CrossRef]

21. Tiago, P.; Gouveia, M.J.; Capinha, C.; Santos-Reis, M.; Pereira, H.M. The influence of motivational factors on the frequency of participation in citizen science activities. *Nat. Conserv.* **2017**, *18*, 61. [CrossRef]

22. Brass, D.J. Being in the right place: A structural analysis of individual influence in an organization. *Adm. Sci. Q.* **1984**, 518–539. [CrossRef]

23. Baumeister, R.F.; Leary, M.R. The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychol. Bull.* **1995**, *117*, 497. [CrossRef] [PubMed]

24. Ryan, R.M.; Deci, E.L. Intrinsic and extrinsic motivations: Classic definitions and new directions. *Contemp. Educ. Psychol.* **2000**, *25*, 54–67. [CrossRef]

25. Tajfel, H. Social psychology of intergroup relations. *Annu. Rev. Psychol.* **1982**, *33*, 1–39. [CrossRef]

26. Cross, S.E.; Bacon, P.L.; Morris, M.L. The relational-interdependent self-construal and relationships. *J. Personal. Soc. Psychol.* **2000**, *78*, 791. [CrossRef]

27. Singelis, T.M. The measurement of independent and interdependent self-construals. *Personal. Soc. Psychol. Bull.* **1994**, *20*, 580–591. [CrossRef]

28. Kinket, B.; Verkuyten, M. Levels of ethnic self-identification and social context. *Soc. Psychol. Q.* **1997**, *60*, 338–354. [CrossRef]

29. Rosenberg, M. *Conceiving the Self*; RE Krieger: Malabar, FL, USA, 1986.

30. Tropp, L.R.; Wright, S.C. Ingroup identification as the inclusion of ingroup in the self. *Personal. Soc. Psychol. Bull.* **2001**, *27*, 585–600. [CrossRef]

31. Bandura, A. Exercise of human agency through collective efficacy. *Curr. Dir. Psychol. Sci.* **2000**, *9*, 75–78. [CrossRef]

32. Ellen, P.S.; Wiener, J.L.; Cobb-Walgren, C. The role of perceived consumer effectiveness in motivating environmentally conscious behaviors. *J. Public Policy Mark.* **1991**, *10*, 102–117. [CrossRef]

33. Triandis, H.C. Individualism-collectivism and personality. *J. Personal.* **2001**, *69*, 907–924. [CrossRef] [PubMed]

34. Cojuharenco, I.; Cornelissen, G.; Karelaia, N. Yes, I can: Feeling connected to others increases perceived effectiveness and socially responsible behavior. *J. Environ. Psychol.* **2016**, *48*, 75–86. [CrossRef]

35. Gärling, T.; Fujii, S.; Gärling, A.; Jakobsson, C. Moderating effects of social value orientation on determinants of proenvironmental behavior intention. *J. Environ. Psychol.* **2003**, *23*, 1–9. [CrossRef]

36. Kelley, H.H.; Thibaut, J.W. *Interpersonal Relations: A Theory of Interdependence*; Wiley: New York, NY, USA, 1978.

37. Van Lange, P.A.; Vugt, M.V.; Meertens, R.M.; Ruiter, R.A. A Social Dilemma Analysis of Commuting Preferences: The Roles of Social Value Orientation and Trust 1. *J. Appl. Soc. Psychol.* **1998**, *28*, 796–820. [CrossRef]

38. Seidman, I. *Interviewing as Qualitative Research: A Guide for Researchers in Education and the Social Sciences*; Teachers College Press: New York, NY, USA, 2006.

39. Minichiello, V.; Aroni, R.; Hays, T.N. *In-Depth Interviewing: Principles, Techniques, Analysis*; Pearson Education Australia: Frenchs Forest, Australia, 2008.

40. Kumar, R. *Research Methodology: A Step-by-Step Guide for Beginners*; Sage: London, UK, 2018.

41. Crabtree, B.F.; Miller, W.L. Doing qualitative research. In Proceedings of the Annual North American Primary Care Research Group Meeting, Quebec, QC, Canada, 19 May 1989.

42. Krippendorff, K. Validity in Content Analysis. In *Computerstrategien für die Kommunkationsanalyse*; Mochmann, E., Ed.; Campus-Verlag: Frankfurt, Germany, 1980; pp. 69–112.

43. Fang, W.-T.; Ng, E.; Wang, C.-M.; Hsu, M.-L. Normative beliefs, attitudes, and social norms: People reduce waste as an index of social relationships when spending leisure time. *Sustainability* **2017**, *9*, 1696. [CrossRef]

44. Typhina, E. Urban park design+ love for nature: Interventions for visitor experiences and social networking. *Environ. Educ. Res.* **2017**, *23*, 1169–1181. [CrossRef]

45. Bonney, R.; Cooper, C.B.; Dickinson, J.; Kelling, S.; Phillips, T.; Rosenberg, K.V.; Shirk, J. Citizen science: A developing tool for expanding science knowledge and scientific literacy. *BioScience* **2009**, *59*, 977–984. [CrossRef]

46. Flèche, S.; Clark, A.E.; Layard, R.; Powdthavee, N.; Ward, G. *The Origins of Happiness: The Science of Well-Being over the Life Course*; Princeton University Press: Princeton, NJ, USA, 2019.
47. Stern, P.C. New environmental theories: Toward a coherent theory of environmentally significant behavior. *J. Soc. Issues* **2000**, *56*, 407–424. [CrossRef]
48. Stern, P.C.; Dietz, T.; Abel, T.; Guagnano, G.A.; Kalof, L. A value-belief-norm theory of support for social movements: The case of environmentalism. *Hum. Ecol. Rev.* **1999**, *6*, 81–97.
49. Hines, J.M.; Hungerford, H.R.; Tomera, A.N. Analysis and synthesis of research on responsible environmental behavior: A meta-analysis. *J. Environ. Educ.* **1987**, *18*, 1–8. [CrossRef]
50. Larson, L.R.; Stedman, R.C.; Cooper, C.B.; Decker, D.J. Understanding the multi-dimensional structure of pro-environmental behavior. *J. Environ. Psychol.* **2015**, *43*, 112–124. [CrossRef]
51. Kellert, S.R. *Building for Life: Designing and Understanding the Human-Nature Connection*; Island Press: Washington, DC, USA, 2012.
52. Clayton, S.; Luebke, J.; Saunders, C.; Matiasek, J.; Grajal, A. Connecting to nature at the zoo: Implications for responding to climate change. *Environ. Educ. Res.* **2014**, *20*, 460–475. [CrossRef]
53. Kahyaoğlu, M. The research of the relationship between environmentally aware prospective teachers' qualities and self efficacy beliefs towards environmental education. *Procedia-Soc. Behav. Sci.* **2014**, *116*, 4493–4497. [CrossRef]
54. White, R.L.; Eberstein, K.; Scott, D.M. Birds in the playground: Evaluating the effectiveness of an urban environmental education project in enhancing school children's awareness, knowledge and attitudes towards local wildlife. *PLoS ONE* **2018**, *13*, e0193993. [CrossRef]
55. Ridings, C.M.; Gefen, D. Virtual community attraction: Why people hang out online. *J. Comput. Mediat. Commun.* **2004**, *10*, JCMC10110. [CrossRef]
56. Preece, J.; Ghozati, K. In search of empathy online: A review of 100 online communities. In Proceedings of the Americas Conference on Information Systems (AMCIS 1998), Baltimore, MD, USA, 14–16 August 1998; pp. 92–94.
57. Constant, D.; Sproull, L.; Kiesler, S. The kindness of strangers: The usefulness of electronic weak ties for technical advice. *Organ. Sci.* **1996**, *7*, 119–135. [CrossRef]
58. Granovetter, M.S. The strength of weak ties. *Am. J. Sociol.* **1973**, *78*, 1360–1380. [CrossRef]
59. Granovetter, M. The strength of weak ties: A Network Theory revisited. *Sociological Theory* **1983**, *1*, 201–233. [CrossRef]
60. Granovetter, M. *Granovetter Replies to Gans*; University of Chicago Press: Chicago, IL, USA, 1974.
61. Li, D.; Zhao, L.; Ma, S.; Shao, S.; Zhang, L. What influences an individual's pro-environmental behavior? A literature review. *Resour. Conserv. Recycl.* **2019**, *146*, 28–34. [CrossRef]
62. Allen, J.B.; Ferrand, J.L. Environmental locus of control, sympathy, and proenvironmental behavior: A test of Geller's actively caring hypothesis. *Environ. Behav.* **1999**, *31*, 338–353. [CrossRef]
63. Kals, E.; Schumacher, D.; Montada, L. Emotional affinity toward nature as a motivational basis to protect nature. *Environ. Behav.* **1999**, *31*, 178–202. [CrossRef]
64. Szagun, G.; Pavlov, V.I. Environmental awareness: A comparative study of German and Russian adolescents. *Youth Soc.* **1995**, *27*, 93–112. [CrossRef]
65. Bonaiuto, M.; Fornara, F.; Bonnes, M. Indexes of perceived residential environment quality and neighbourhood attachment in urban environments: A confirmation study on the city of Rome. *Landsc. Urban. Plan.* **2003**, *65*, 41–52. [CrossRef]
66. Chu, S.-C.; Kim, Y. Determinants of consumer engagement in electronic word-of-mouth (eWOM) in social networking sites. *Int. J. Advert.* **2011**, *30*, 47–75. [CrossRef]
67. Zeng, F.; Huang, L.; Dou, W. Social factors in user perceptions and responses to advertising in online social networking communities. *J. Interact. Advert.* **2009**, *10*, 1–13. [CrossRef]
68. Schwartz, S.H. Normative influences on altruism. In *Advances in Experimental Social Psychology*; Elsevier: Amsterdam, The Netherlands, 1977; Volume 10, pp. 221–279.
69. Ahn, J.-M.; Koo, D.-M.; Chang, H.-S. Different impacts of normative influences on pro-environmental purchasing behavior explained by differences in individual characteristics. *J. Glob. Sch. Mark. Sci.* **2012**, *22*, 163–182. [CrossRef]
70. Vining, J.; Ebreo, A. Emerging theoretical and methodological perspectives on conservation behavior. In *Handbook of Environmental Psychology*; John Wiley & Sons, Inc.: Hoboken, NJ, USA, 2002.
71. Gosling, E.; Williams, K.J. Connectedness to nature, place attachment and conservation behaviour: Testing connectedness theory among farmers. *J. Environ. Psychol.* **2010**, *30*, 298–304. [CrossRef]
72. Ballantyne, R.; Packer, J.; Sutherland, L.A. Visitors' memories of wildlife tourism: Implications for the design of powerful interpretive experiences. *Tour. Manag.* **2011**, *32*, 770–779. [CrossRef]
73. Davis, J.L.; Green, J.D.; Reed, A. Interdependence with the environment: Commitment, interconnectedness, and environmental behavior. *J. Environ. Psychol.* **2009**, *29*, 173–180. [CrossRef]